

BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 2

AUGUST 1954

PART 12



PRESIDENTIAL BADGE.

Presented to the Institute by the Directors of Messrs. Johnson, Matthey and Co., Ltd., on the occasion of the recent Spring Meeting.

INSTITUTE NEWS

Papers for the Journal : Memorandum for Prospective Authors

The high cost of printing, paper, and binding, coupled with the large number of manuscripts now being received, force the Publication Committee to insist on conciseness in the presentation of papers submitted for the *Journal*. In future, the Committee will consider and accept only manuscripts that are concisely written, well presented, and illustrated with the minimum possible number of diagrams and photographs. Economy is specially necessary in regard to half-tone illustrations, as the printing and binding of plates represent particularly heavy items in the cost of producing the *Journal*.

It is the general opinion of members of the Committee and of referees that few papers are submitted that could not have been written more succinctly. In this connection the Committee wishes to emphasize that theses and reports prepared for circulation within an author's organization are very rarely in a form suitable for submission as papers to be published by a scientific society. Such manuscripts normally need very critical examination, and thorough revision before they are submitted for consideration by the Publication Committee, and the Committee looks to heads of laboratories from which many of the papers published in the *Journal* come, to ensure that this is done. In the past authors have all too frequently left to referees or to Committee members the task of suggesting how papers might be revised and made acceptable for the *Journal*.

Autumn Meeting, Switzerland : Amendments to Programme

All members resident in Europe should now have received a separately-printed programme with Reply Form.

This programme includes amendments to that which was printed in the July issue of the *Bulletin*, pp. 121-129. The amendments are as follows :

Tuesday, 7 September, Afternoon. The ladies will now visit the Uetliberg (2,884 ft.) by train and have tea, instead of visiting a series of museums.

Tuesday, 14 September. If the total numbers for Group 1 do not reach 50, the party will leave Montreux by normal train service and the visit to Fonderie Boillat S.A. will have to be omitted. Group 2 will leave Montreux at 9.18 a.m. and not 7.51 a.m. as published in the *Bulletin* for July.

Election of Members

The following 4 Ordinary Members and 1 Student Member were elected on 9 June 1954 :

As Ordinary Members

- BLASE, Emil Frederick, M.S., Chief Chemist, Sangamo Electric Company, Springfield, Ill., U.S.A.
 MEIGH, Walter Charles, Director and Secretary, Meigh Castings, Ltd., Uckington Foundry, Cheltenham.
 MENTER, James Woodham, M.A., Ph.D., A.Inst.P., I.C.I. Fellow, Research Laboratory for Physics and Chemistry of Surfaces, Department of Physical Chemistry, Cambridge.
 SHILSTONE, Cecil M., B.S., Shilstone Testing Laboratory, 814 Conti Street, New Orleans 16, La., U.S.A.

As Student Member

BROTHERTON, Peter Herbert John, Metallographer, Garringtons, Ltd., The Green, Darlaston, Staffs.

The following 14 Ordinary Members, 3 Junior Members, and 2 Student Members were elected on 1 July 1954 :

As Ordinary Members

- BROWNIDGE, Allan John Michael, Technical Representative, North London Heat Treatment, Ltd., Bunns Lane, London, N.W.7.
 CARLSON, Eugene Elmer, B.Met.Eng., Metallurgist, Federal Mogul Corporation, 2355 Stadium Boulevard (Research Division), Ann Arbor, Mich., U.S.A.
 CARRINGTON, Wilfred Ernest, Experimental Officer, Metallurgy Division, National Physical Laboratory, Teddington, Middlesex.
 ELION, Paul Alfred Marie, Président du Conseil d'Administration, Centre d'Information Cuivre, Laitons, Alliages, 58 rue de Lisbonne, Paris 8e, France.
 FUSTINONI, Francesco Alberto, Dott.Chim., Joint Technical Manager, Metallurgica Feltrina S.P.A., via F. Turati 18, Milano, Italy.
 GAUKER, Harley Francis, Engineer, Ajax Engineering Corporation, Lalor and Hancock Streets, Trenton, N.J., U.S.A.
 JOSEPH, Professor Thomas L., M.A., Professor of Metallurgy and Assistant Dean, Minnesota Institute of Technology, University of Minnesota, Minneapolis 14, Minn., U.S.A.
 KLAT, Elie, Engineer-Managing Director, Delta Steel Mill and Electro Cable Egypte, 18 Rue Emad El Dine, Cairo, Egypt.
 LENGBRIDGE, John W., Project Engineer, Aluminum Goods, Ltd., 158 Sterling Road, Toronto, Ont., Canada.
 LEYMAN, Reginald Edwin, B.Sc., Metallurgist, Research Department, African Explosives and Chemical Industries, Ltd., P.O. Northrand, Transvaal, South Africa.
 NIELSEN, Herman, B.Sc., General Manager, Midland Section, Richard Thomas and Baldwins, Ltd., Wilden Works, Stourport-on-Severn, Worcs.
 NORDHEIM, Rolf, Chem.Eng., Sc.D., Research Metallurgist, Norwegian Defence Research Establishment, Lilleström, Norway.
 THOMAS, Kurt, Dr.-Ing., Geschäftsführer des Vereins Deutscher Eisenhüttenleute, Breitestrasse 27, Düsseldorf, Germany.
 TZSCHASCHSEL, Hans, Dipl.Ing., Betriebsdirektor, Norddeutsche Affinerie, Alsterterrasse 2, Hamburg 36, Germany.

As Junior Members

- LEWIS, Gerald Ivor, L.I.M., Metallographist, Royal Aircraft Establishment, Farnborough, Hants.
 ROSE, Howard Compton, B.Sc., Investigator, Development and Research Department, The Mond Nickel Co., Ltd., Wiggin Street, Birmingham 16.
 VELTMAN, Herbert, Diplomkandidat, Institut für Metallhüttenkunde und Elektrometallurgie, Technische Hochschule, Aachen, Germany.

As Student Members

- GRAHAM, James, M.Sc., Research Student, Department of Metallurgy, University of Birmingham.
 HELLAWELL, Angus, B.A., B.I.S.R.A. Bursar, Inorganic Chemistry Laboratory, South Parks Road, Oxford.

COUNCIL 1954-55

President :

Dorey, S. F., C.B.E., D.Sc., F.R.S., M.I.Mech.E., M.I.C.E.; Chief Engineer Surveyor, Lloyd's Register of Shipping, London.

Past-Presidents :

Murphy, Professor A. J., M.Sc., F.I.M.; Head of the Department of Metallurgy, University of Birmingham.

Smithells, C. J., M.C., D.Sc., F.I.M.; Director of Research, The British Aluminium Co., Ltd., Gerrards Cross, Bucks.

Thompson, Professor F. C., D.Met., M.Sc., F.I.M.; Professor of Metallurgy, University of Manchester.

Vice-Presidents :

Bailey, G. L., C.B.E., M.Sc., F.I.M.; Director, The British Non-Ferrous Metals Research Association, London.

Ball, Major C. J. P., D.S.O., M.C., F.R.Ae.S.; Member of the Management Committee of The Distillers Co., Ltd.; Chairman and Managing Director, Magnesium Elektron Ltd.; Managing Director, F. A. Hughes and Co., Ltd.; Director, Sterling Metals, Ltd.

Cook, Maurice, D.Sc., Ph.D., F.I.M.; Joint Managing Director, Imperial Chemical Industries Ltd., Metals Division. (*Senior Vice-President*.)

Pfeil, L. B., O.B.E., D.Sc., A.R.S.M., F.R.S.; Director, The Mond Nickel Co., Ltd.; Director, Henry Wiggin and Co., Ltd.

Raynor, Professor G. V., D.Sc., D.Phil., M.A., F.R.I.C., F.Inst.P., A.I.M.; Professor of Physical Metallurgy, University of Birmingham.

Teed, Major P. Litherland, A.R.S.M., F.R.Ae.S., F.I.M., M.I.M.M.; Assistant Chief of Aeronautical Research and Development, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey.

Honorary Treasurer :

Colquhoun, J. G., M.B.E., Chairman and Managing Director, The Manganese Bronze and Brass Co., Ltd., Ipswich and Birkenhead; Chairman, Lightalloys Ltd., London.

Ordinary Members of Council :

Baer, Alfred M., B.A.; Vice-Chairman, The Consolidated Zinc Corporation, Ltd.; Chairman, H. J. Enthoven and Sons, Ltd.; Director, Imperial Smelting Corporation, Ltd.; Director, The Zinc Corporation, Ltd.; Director, New Broken Hill Consolidated, Ltd.; Director, British Titan Products Ltd.; Director, National Alloys, Ltd.

Baker, W. A., D.Sc., F.I.M.; Research Manager, British Non-Ferrous Metals Research Association, London.

Bond-Williams, N. I., B.Sc., A.I.M.; Chairman and Managing Director, The Aston Chain and Hook Co., Ltd., Birmingham; Director, Midland Laboratory Guild (1928), Ltd.

Clarke, K. W., F.I.M.; Chief Metallurgist, The de Havilland Aircraft Co., Ltd., Central Laboratories, Edgware.

Gadd, E. R., F.I.M.; Chief Metallurgist, The Bristol Aeroplane Co., Ltd., Engine Division, Filton, Bristol.

Grimston, The Hon. John, M.P.; Director and General Manager, Enfield Rolling Mills, Ltd., Brimsdown, Enfield; Director, Enfield Copper Refining Co. Ltd.; Director, Enfield Rolling Mills (Aluminium) Ltd.; Director, Enfield Zinc Products, Ltd.; Director, London Zinc Mills, Ltd.; Director, Holloway Metal Roofs, Ltd.

Hamer, R. D., B.Sc., F.I.M.; Vice-President and Director, Aluminium Laboratories Ltd.; Director, Magnesium Company of Canada, Ltd.

Inglis, N. P., Ph.D., M.Eng., M.I.Mech.E., F.I.M.; Research Director, Imperial Chemical Industries, Ltd., Metals Division, Birmingham.

Jenkins, Ivor, D.Sc., F.I.M.; Chief Metallurgist, Research Laboratories of The General Electric Co., Ltd., Wembley, Middlesex.

Jones, E. H., A.R.I.C., M.I.M.M., F.I.M.; Joint Managing Director, Capper Pass and Son, Ltd., Bristol.

Ramsay, A. G., Ph.D., B.Sc., A.R.I.C.; Director, The Mond Nickel Co., Ltd., Swansea.

Smith, Christopher, F.I.M.; Works Superintendent, James Booth and Co., Ltd., Birmingham.

Sutton, H., C.B.E., D.Sc., F.R.Ae.S., F.I.M.; Director, Materials Research and Development (Air), Ministry of Supply.

Thomas, W. J., M.I.Mech.E., M.I.E.E.; Joint Managing Director, The British Aluminium Co., Ltd.; Director, North British Aluminium Co., Ltd.; Director, Lochaber Power Co.; Director, Imperial Magnesium Corporation, Ltd.; Director, William Mills, Ltd.; Director, Alumina Co., Ltd.; Director, Gold Coast Bauxite Co., Ltd.; Director, Aluminium Corporation, Ltd.; Director, British and Colonial Bauxite Co., Ltd.; Director, Alliance Aluminium Holdings, Ltd.; Director, Aluminium Wire and Cable Co., Ltd.

Tinker, G. P., M.Sc., F.I.M.; Managing Director, Birlec Ltd.; Director, Birmingham Electric Furnaces, Ltd.; Director, Maiden and Co., Ltd.

Ex-officio : Chairmen of Local Sections**Birmingham**

Smith, S. S., M.Met., F.I.M.; Research Manager, Imperial Chemical Industries, Ltd., Metals Division, Birmingham.

London

Chaston, J. C., B.Sc., Ph.D., A.R.S.M., F.I.M.; Manager, Research Laboratories, Johnson, Matthey and Co., Ltd., Wembley, Middlesex.

Oxford

Parker, R. T., Ph.D., B.Sc., A.R.S.M., Director of Research, Aluminium Laboratories, Ltd., Banbury, Oxon.

Scottish

MacDonald, G., O.B.E., B.Sc., A.M.I.C.E., M.I.Mech.E., Technical Manager and Director, E. Chalmers and Co., Ltd., Edinburgh.

Sheffield

Maddocks, W. R., Ph.D., B.Sc., Senior Lecturer in Production Metallurgy, University of Sheffield.

South Wales

Walton, J. S., F.I.M., Metallurgist, Research and Development Division, High Duty Alloys, Ltd., Briton Ferry, Glam.

Representatives of Other Bodies :

The following, in accordance with Article 32, represent Government departments and allied societies at Council meetings, for purposes of liaison :

The Admiralty

Grylls, Rear Admiral (E.) H. J. B., R.N.

The War Office

Lord, Major-General W. A., C.B.E.

The Institution of Metallurgists

Cook, Maurice, D.Sc., Ph.D., F.I.M.

West, E. G., Ph.D., B.Sc., F.I.M.

The Iron and Steel Institute

Lyttelton, The Hon. R. G.

Honorary Corresponding Members to the Council

Australia : Professor H. K. Worner, D.Sc.

Belgium : H. P. A. Féron.

Canada : G. S. Farnham, Ph.D., M.Sc., and Professor F. A. Forward, B.A.Sc.

France : Professor P. A. J. Chevenard and J. Matter.

India : N. P. Gandhi, M.A., B.Sc., A.R.S.M., D.I.C.

Italy : Leon Matteoli, Dott.Chim.

Netherlands : M. Hamburger.

South Africa : G. H. Stanley, D.Sc., A.R.S.M., and Professor L. Taverner, A.R.S.M., D.I.C.

Spain : Professor J. Orland, M.Sc., M.A., Ph.D., D.D.

Sweden : Professor Carl A. F. Benedicks, Fil.Dr., Dr.Ing.e.h., Dr. Techn.h.c., and Professor Axel Hultgren.

Switzerland : Professor A. von Zeerleder, Dr.-Ing., and Dr. O. H. C. Messner.

United States of America : Professor R. F. Mehl, Ph.D., Hon.Eng.D., Hon. Sc.D., Professor C. S. Smith, Sc.D., and Dr. R. A. Wilkins.

Committees for 1954-55**Finance and General Purposes Committee**

JONES, Mr. E. H. (*Chairman*).

BAILEY, Mr. G. L.

GRIMSTON, The Hon. John.

MURPHY, Professor A. J.

RAMSAY, Dr. A. G.

SMITHELLS, Dr. C. J.

TEED, Major P. L.

THOMPSON, Professor F. C.

Ex-officio :

DOREY, Dr. S. F. (*President*).

COOK, Dr. M. (*Senior Vice-President*).

COLQUHON, Mr. J. C. (*Honorary Treasurer*).

SMITH, Mr. C. (*Chairman, Publication Committee*).

Local Sections Committee

PFEIL, Dr. L. B. (*Chairman*).

ASHTON, Mr. A. B.

GARSDIE, Dr. J. E.

KENNETT, Dr. S. J.

Ex-officio :

DOREY, Dr. S. F. (*President*).

COOK, Dr. M. (*Senior Vice-President*).

COLQUHOUN, Mr. J. C. (*Honorary Treasurer*).

SMITH, Mr. S. S. (*Chairman, Birmingham Local Section*).

MATTHEWS, Mr. A. W. (*Honorary Secretary, Birmingham Local Section*).

CHASTON, Dr. J. C. (*Chairman, London Local Section*).

KNIGHT, Mr. J. R. (*Honorary Secretary, London Local Section*).

PARKER, Dr. R. T. (*Chairman, Oxford Local Section*).

SMITH, Mr. O. R. (*Honorary Secretary, Oxford Local Section*).

MACDONALD, Mr. G. (*Chairman, Scottish Local Section*).

HAY, Mr. Matthew (*Honorary Secretary, Scottish Local Section*).

MADDOCKS, Dr. W. R. (*Chairman, Sheffield Local Section*).

MACDOUGALL, Mr. A. J. (*Honorary Secretary, Sheffield Local Section*).

WALTON, Mr. J. S. (*Chairman, South Wales Local Section*).

CUNNIFE, Mr. P. W. A. (*Honorary Secretary, South Wales Local Section*).

Metal Physics Committee

RAYNOR, Professor G. V. (*Chairman*).

AXON, Dr. H. J.

BAILEY, Dr. G. L. J.

CHRISTIAN, Dr. J. W.

FINNISTON, Dr. H. M.

FORSYTH, Mr. P. J. E. (co-opted).

FRANK, Dr. F. C.

GEACH, Dr. G. A.

HANSTOCK, Dr. R. F.

KING, Mr. R.

NUTTING, Dr. J.

OLIVER, Mr. D. A. (representing the Iron and Steel Institute and the British Iron and Steel Research Association).

RICHARDS, Dr. T. L.

RICHARDSON, Dr. F. D.

SULLY, Dr. A. H.

WAKEMAN, Dr. D. W.

Ex-officio :

DOREY, Dr. S. F. (*President*).

SMITH, Mr. C. (*Chairman, Publication Committee*).

Metallurgical Engineering Committee

THOMAS, Mr. W. J. (*Chairman*).

BAKER, Dr. W. A.

BOLTON, Mr. E. A.

BOND-WILLIAMS, Mr. N. I.

BOWMAN, Mr. W. H.

CAMPBELL, Mr. D. F.

DAVIES, Mr. C. E.

FORD, Professor H.

LAKE, Mr. N. C.

MILLER, Mr. H. J.

PATON, Mr. C. P.

SALTER, Mr. J.

SINGER, Dr. A. R. E.

SWINDELLS, Dr. N.

WALTON, Mr. J. S.

WILKINSON, Mr. R. G.

Ex-officio :

DOREY, Dr. S. F. (*President*).

SMITH, Mr. C. (*Chairman, Publication Committee*).

LOCAL SECTION OFFICERS AND COMMITTEES 1954-55

Publication Committee

SMITH, Mr. Christopher (*Chairman*).
BAILEY, Mr. R. W.
BAKER, Dr. W. A.
FINNISTON, Dr. H. M.
FORD, Professor H.
HUDSON, Mr. F.
INGLIS, Dr. N. P.
JENKINS, Dr. Ivor.
PARKER, Dr. R. T.
PFEIL, Dr. L. B. (representing Local Sections Committee).
PHILLIPS, Mr. H. W. L.
POWELL, Mr. A. R.
SHOWELL, Mr. D. W. D.

Ex-officio :

DOREY, Dr. S. F. (*President*).
JONES, Mr. E. H. (*Chairman, Finance and General Purposes Committee*).
COLQUHOUN, Mr. J. C. (*Honorary Treasurer*).
RAYNOR, Professor G. V. (*Chairman, Metal Physics Committee*).
THOMAS, Mr. W. J. (*Chairman, Metallurgical Engineering Committee*).

The constitution of certain Committees is fixed by standing orders of the Council, as follows :

Medal Committee

PRESIDENT (*Chairman*).
SENIOR VICE-PRESIDENT

and

Not more than four Institute of Metals (Platinum) Medallists who are, or have been, members of the Council (to be selected by the President), with power to the President to co-opt not more than two other persons.

Nominations Committee

PRESIDENT.
TWO IMMEDIATE PAST-PRESIDENTS.
SENIOR VICE-PRESIDENT.

Staff Committee

PRESIDENT.
SENIOR VICE-PRESIDENT.
CHAIRMAN, FINANCE COMMITTEE.
HONORARY TREASURER.

Local Section Officers and Committees for Session 1954-55

Birmingham Local Section

Chairman: S. S. Smith, M.Met., F.I.M.
Vice-Chairman and Representative on Co-ordinating Committee:
H. W. G. Hignett, B.Sc., F.R.I.C., F.I.M.
Hon. Secretary: A. W. Matthews, A.I.M.
Asst. Hon. Secretary: P. Hutchinson.
Hon. Treasurer: R. Chadwick, M.A., F.R.I.C., F.I.M.
Past-Chairmen: B. Thomas, F.Inst.P., A.I.M.; E. A. Bolton, M.Sc., F.I.M.; H. H. Symonds, F.I.M.
Ordinary Members: L. H. Fairbank, B.Sc., A.I.M.; J. O. Hitchcock, B.Sc., F.I.M.; C. E. Homer, Ph.D., B.Sc., F.I.M.; W. H. L. Hooper, B.Sc., A.I.M.; J. W. Jenkin, Ph.D., B.Sc., F.I.M.; L. G. Tottle, A.R.Ae.S., L.I.M.

London Local Section

Chairman: J. C. Chaston, Ph.D., B.Sc., A.R.S.M., F.I.M.
Vice-Chairman: E. C. Rhodes, Ph.D., B.Sc., F.R.I.C., F.I.M.

Hon. Secretary: J. R. Knight, B.Sc., A.I.M.
Hon. Treasurer: E. G. V. Newman, B.Sc., A.R.S.M., A.R.I.C., F.I.M.

Past-Chairmen: E. A. G. Liddiard, M.A., F.I.M.; W. F. Randall, B.Sc., A.R.S.M., F.I.M.; C. E. Ransley, Ph.D., M.Sc., F.I.M.

Ordinary Members: G. L. J. Bailey, Ph.D., B.Sc., A.R.C.S., D.I.C., F.Inst.P.; J. A. Catterall, Ph.D., B.Sc., A.R.S.M.; R. G. Harper, M.Sc.; Ivor Jenkins, D.Sc., F.I.M.; E. C. J. Marsh, B.Sc., F.R.I.C., F.I.M.; W. K. B. Marshall, B.Eng., A.I.M.

Oxford Local Section

Chairman: R. T. Parker, Ph.D., B.Sc., A.R.S.M., F.R.I.C., F.I.M.

Vice-Chairmen: W. Hume-Rothery, O.B.E., F.R.S., D.Sc.; G. Murray, M.Sc., F.I.M.

Hon. Secretary: O. R. Smith, B.Sc., F.I.M.

Hon. Treasurer: J. C. Arrowsmith, M.Met.

Past-Chairman: H. M. Finniston, Ph.D., B.Sc., A.R.T.C.

Ordinary Members: A. T. Churchman, Ph.D., B.Sc.; G. C. Ellis; R. H. Goddard; A. Hellawell, B.A.; G. L. Hopkin, B.Sc., F.I.M.; R. Pearce, B.A., B.Sc.; A. A. Pearson, A.I.M.; S. F. Pugh, M.A., A.I.M.; A. E. W. Smith, Ph.D., B.Sc., F.I.M.; A. N. Turner, Ph.D., B.Sc., A.R.S.M., A.I.M.

Scottish Local Section

Chairman: George MacDonald, O.B.E., B.Sc.

Vice-Chairman: W. A. Dunlop.

Hon. Secretary: Matthew Hay.

Hon. Treasurer: N. J. MacLeod.

Past-Chairmen: John Arnott, F.R.I.C., F.I.M.; E. A. Fowler, B.Sc., A.R.T.C.

Ordinary Members: H. B. Bell, B.Sc., A.R.T.C.; R. E. Buttress (representing Associates); E. G. Flack; J. Gorman (representing Associates); H. Harris, Ph.D., B.Sc., A.R.C.S., D.I.C.; F. Kasz, B.Sc.; H. S. S. Murray; A. L. Wakeling.

Sheffield Local Section

Chairman: W. R. Maddocks, Ph.D., B.Sc.

Vice-Chairman: A. Edwards, Ph.D., B.Sc., F.I.M.

Hon. Secretary and Treasurer: A. J. MacDougall, M.Met., F.I.M.

Asst. Hon. Secretary: B. C. Woodfine, Ph.D., B.Met.

Past-Chairmen: F. Orme, T. D., M.Met., A.R.I.C., F.I.M.; H. G. Dale, F.R.I.C.; M. M. Hallett, M.Sc., F.I.M.

Ordinary Members: T. B. Bowker; H. Gadsby, A.Met.; R. W. K. Honeycombe, Ph.D., M.Sc.; B. J. Nield, B.Met.; A. G. Quarrell, D.Sc., Ph.D., A.R.C.S., F.Inst.P., F.I.M.; Z. Stokowiec, A.M.I.Mech.E., F.I.M.

South Wales Local Section

Chairman: J. S. Walton, F.I.M.

Hon. Secretary: P. W. A. Cuniffe.

Hon. Treasurer: P. J. Liptrot, M.Eng., A.I.M.

Past-Chairmen: E. A. Hontoir, B.Sc., A.I.M.; D. W. Hopkins, M.Sc., F.I.M.; K. M. Spring, A.I.M.

Ordinary Members: C. F. J. Francis-Carter, O.B.E.; R. H. Humphries (representing Associate Members); H. C. Hulme; B. J. Jones, A.I.M. (representing Junior Members); F. King, A.I.M.; T. B. Marsden, B.Sc. (representing Student Members); H. O'Neill, D.Sc., M.Met., F.I.M.

PERSONAL NOTES

MR. S. C. ANTHONY has received the Insignia Award in Technology of the City and Guilds of London Institute.

MR. J. H. AULD has been transferred from the Crystal Physics Section of the Defence Research Laboratories to the Crystal Physics Section of the Aeronautical Research Laboratories, Melbourne.

MR. W. E. BALLARD has been elected a Member of Council of the Institution of Metallurgists, representing the Fellows.

MR. W. BARR, Chief Metallurgist and Executive Director, Colvilles, Ltd., Motherwell, has been elected President of the Institution of Metallurgists for the year 1954-55.

MR. G. W. BROWN has left Douglas (Kingswood), Ltd., Bristol, and is now with Newman, Hender and Co., Ltd., Woodchester, Glos.

MR. A. C. BURNINGHAM has been appointed Deputy Managing Director of British Chrome and Chemicals, Ltd., Eaglescliffe, Stockton-on-Tees. He is no longer Joint Managing Director of The Eaglescliffe Chemical Co., Ltd., although he is still on the Board of this Company.

DR. B. R. COLES, Lecturer in Metal Physics at the Imperial College of Science and Technology, has been awarded a United States Government (F.O.A.) Fellowship which will enable him to spend a year at the Carnegie Institute of Technology, Pittsburgh, Pa. He leaves for America early in September.

MR. G. L. COOPER has left Sheffield University and has been appointed Information Officer to the Metallurgy Division of the Atomic Energy Research Establishment, Harwell.

MR. K. G. DUNN has been appointed Chief Inspector, Blackburn (Dumbarton), Ltd., Scotland.

DR. A. B. EVEREST has been elected Senior Vice-President of the Institute of British Foundrymen for the year 1954-55.

MR. C. C. HANSON has taken up a post as Research Metallurgist with Radiation, Ltd., Aston, Birmingham.

DR. A. R. HARDING has left Birmingham University to join the staff of Aluminium Laboratories, Limited, Banbury.

MR. H. G. HERRINGTON, Managing Director of High Duty Alloys, Ltd., received the C.B.E. in the Birthday Honours' List.

DR. K. J. IRVINE has left the University of Leeds and is now attached to the Research and Development Section, The United Steel Companies, Ltd., Rotherham.

MR. D. JAMES has resigned his position as Managing Director of Baker Platinum, Ltd.

DR. IVOR JENKINS has been elected a Member of Council of the Institution of Metallurgists, representing the Associates.

MR. P. C. KIRBY has left J. Stone and Co., Ltd., and has joined the E.N.V. Engineering Co., Ltd., Willesden, as Metallurgist.

MR. I. MINKOFF has been doing research work at the Massachusetts Institute of Technology under their Foreign Student Summer Prize Project. He will be visiting England during December before returning to Israel.

MR. N. L. MOCHEL, Manager of Metallurgical Engineering, Westinghouse Electric Corp., has been elected President of the American Society for Testing Materials for the year 1954-55.

PROFESSOR A. J. MURPHY has been elected a Member of Council of the Institution of Metallurgists, representing the Fellows.

PROFESSOR E. A. OWEN retires in September from the Chair of Physics at the University College of North Wales, Bangor, which he has held for the last 28 years. Before going to Bangor he was head of the Radiology Section of the Physics Department of the National Physical Laboratory, and undertook there some of the earliest X-ray work on the structure of metals and alloys.

MR. L. ROTHERHAM, Assistant Controller, Research and Development, Department of Atomic Energy, has been elected a Vice-President of the Institution of Metallurgists.

MR. R. A. SCHATZEL, Vice-President and Director of Engineering, Rome Cable Corp., Rome, N.Y., has been elected a Vice-President of the American Society for Testing Materials.

MR. N. S. SPENCE is now engaged in the Nuclear Metallurgy Branch, Atomic Energy of Canada, Ltd., Chalk River, Ont.

MR. J. E. SRAWLEY has left the British Columbia Research Council and has been appointed Development Engineer, Meehanite Metal Corp., New Rochelle, N.Y.

M. J. TRANIER has taken up an appointment with "Le Fil Isolé Moderne" at Delle (Terr. de Belfort).

MR. L. H. WALKER has left T. I. Aluminium, Ltd., to take up an appointment with Imperial Chemical Industries, Ltd., Metals Division, Birmingham. Mr. Walker was one of the first Mond Nickel Fellows.

MR. J. F. WHITFIELD has been appointed Chief Engineer at Round Oak Steel Works, Ltd., Brierley Hill, Staffs.

MR. A. L. WILSON has left Rolls-Royce, Ltd., and is now a metallurgist with the Northern Aluminium Co., Ltd., Banbury.

Deaths

The Editor regrets to announce the deaths of:

MR. JOHN EPHRAIM JENKINS, Research Metallurgist, Magnesium Elektron, Ltd., on 26 March 1954.

MR. FRANK PECHAL, Director of Stone-Fry Magnesium, Ltd., on 25 May 1954.

DR.-ING. ADOLF VAMBERSKÝ, of Prague, on 27 April 1954.

DR. CECIL MONTAGUE WALTER, in a London hospital after a long illness, on 19 May 1954. Dr. Walter, who had been retired for a number of years, was formerly connected with the Industrial Research Department of the City of Birmingham Gas Department.

OBITUARY

Mr. E. F. Law

With the passing of Edward Fulton Law, on 22 May 1954, in his seventy-seventh year, the profession of metallurgy loses one of the few of those now remaining who took an active part in the Institute's proceedings at the time of its foundation in 1908 and in the years which followed.

Law was one of that group of young men, which included Merrett, Hudson, Bengough, Carpenter, and Rosenhain, who, in the late nineties and at the turn of the century, came directly under the inspiring influence of Roberts-Austen, working for a time in his private laboratory at the Mint. Law occupied a special niche in the esteem of Roberts-Austen, who had quickly recognized the artistic and literary gifts which he brought to his work—gifts so much akin to his own. He recognized, too, the fastidious precision with which Law applied his exceptional manipulative skill to the rapidly developing art of metallography, a skill which, in later years, did much to enrich the earlier volumes of the Institute's *Journal* and was strikingly exemplified in the illustrations which appeared in his work on "Alloys and Their Industrial Applications", published as one of Griffin's Metallurgical Series in 1909, and followed by later editions. Many of these illustrations are unsurpassed at the present day, and the frontispiece to the volume, showing examples of micro-sections of heat-tinted alloys, represents the first application of colour photography to metallographic work.

A perusal of Law's contributions to the discussions at the first meeting of the Institute will show how wide his metallurgical knowledge and experience had already become. They include contributions to the discussion of papers on "Copper Alloys" (by G. D. Bengough), "Phosphor-Bronze" (by Arnold Philip), and "Intermetallic Compounds" (by C. H. Desch). In the following years he contributed to discussions on many matters of controversial interest at the time.

In 1910, in collaboration with his friend Hudson, with whom he had much in common, he contributed a notable paper on "Phosphor Bronze" and in 1912, came a paper by himself on "The Influence of Oxygen on the Properties of Metals", a matter upon which, until then, attention had not been focused. A feature of both of these papers is the high degree of skill shown by the illustrations for which Law himself was mainly responsible.

But his activities were by no means confined to non-ferrous metallurgy, in fact, his later work and his professional occupations were very largely concerned with ferrous metallurgy and particularly with steel. In 1906 he began a long and close association with the Iron and Steel Institute, of which body his friend Bennett Brough was at that time Secretary. In that year, and in subsequent years, he contributed papers to the *Journal* of that Institute. In 1907 he was awarded the Institute's Carnegie Silver Medal, and after serving for many years on the Council he was elected an Honorary Vice-President in 1950.

It was in those early years that he had formed a close friendship with the late F. W. Harbord. This led to a partnership in consulting work under the name of Messrs. Riley, Harbord, and Law, and at the time of his death he was the senior partner in that firm in association with Mr. Vernon Harbord and Mr. T. G. Howard.

There was an important interlude in Mr. Law's career, however, before this partnership came about. Some time before the war of 1914-18, he had accepted an appointment with

Sir W. G. Armstrong, Whitworth and Co., Ltd., at their Openshaw Works at Manchester. Here he remained in charge of the production of armour plate until 1922, when he returned to Westminster. This appointment had brought him into close association with those responsible for naval construction and with the Admiralty. A consequence of this was that at the outbreak of the Second World War, in 1939, his services were again sought and he was asked to join the late Sir Stanley Goodall at Bath on work for the Admiralty. By arrangement with his partners he was released for this purpose, subsequently resuming his association with them which continued until the time of his death.

Mr. Law's cheerful personality, keen sense of humour, and an aptitude for quickly dispelling a too serious approach to problems in hand had brought him many valued friendships among metallurgists and engineers throughout the country, and in the earlier years of this Institute's existence he had done much towards setting the pattern of good fellowship which has always characterized its proceedings.

S. W. SMITH.

LETTER TO THE EDITOR

Some Observations Relating to the "Wetting" of Titanium with Mercury

Mercury will not "wet" titanium when the two metals are in contact with each other in air. But if a piece of titanium is heated in a sealed, evacuated, clear-silica envelope to about 700° C., so that the superficial oxide film dissolves in the

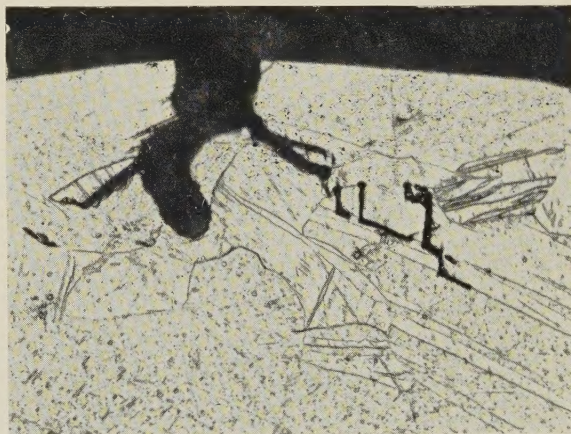


FIG. 1.—Cracked Region in Refined Titanium Which Had Been Coated with Mercury *in vacuo* and Then Bent Through 180°. Specimen polished on 0-1 μ diamond pad, then lightly etched in 2 wt.-% HNO_3 + 1 wt.-% HF in water. $\times 540$.

metal, then mercury will spread on the surface of the titanium, provided that the two metals are brought into contact with each other *in vacuo* while the temperature of the titanium is at least in the vicinity of 400° C. If, after heating to 700° C. *in vacuo*, the titanium is allowed to cool to normal temperatures and then brought into contact with mercury while still *in vacuo*, little or no wetting occurs.

A film of mercury which has been applied to the surface of titanium in the way outlined above will remain on the titanium only as long as the specimen is stored *in vacuo*. As soon as mercury-coated titanium is exposed to air at normal

temperatures, the mercury starts to recede, and after several minutes' contact with air, only a few small areas of the surface remain "wetted" with mercury. Approximately 30 minutes' exposure to air will cause complete recession of the mercury.

Simple bending tests on (a) strips of titanium which had been "wetted" with mercury as described above, and (b) strips which had received similar thermal treatment in the absence of mercury, revealed a definite tendency to superficial brittleness in titanium which had been coated with mercury. This effect, which in some respects is reminiscent of the well-known effects of mercury on brass, was observed in specimens of both refined and commercially pure titanium. The surface cracking was observed even when the specimens were bent after the mercury had apparently receded from the surface of the titanium.

Fig. 1 shows a typical cracked region in refined titanium which had been coated with mercury *in vacuo*, then exposed to air for 15 min., and finally subjected to unsupported bending through 180° over a period of about 10 sec. Initially this specimen was in the annealed condition; it had been heated *in vacuo* for 2 hr. at 700° C., and it possessed an equiaxed grain structure with no twinned crystals. Some of the cracks shown in Fig. 1 are intergranular. However, the most interesting and unusual cracks shown in Fig. 1 are those which appear to have progressed along twin boundaries.

H. W. WORNER

*Physical Metallurgy Section, C.S.I.R.O.,
Baillieu Laboratory,
University of Melbourne.*

NEWS OF LOCAL SECTIONS AND ASSOCIATED SOCIETIES

London Local Section

The Annual General Meeting of the Section took place on 1 April at 4 Grosvenor Gardens, London, S.W.1. After the formal business had been transacted, a discussion took place on:

The Brittle Fracture of Metals

Short introductory talks were given by three speakers.

DR. L. NORTHCOTT (Armament Research Establishment) first considered the Ludwik conception of ductile and brittle fracture by the relation between the cleavage-stress curve and the stress/strain diagram. It appeared to be the rule that the face-centred cubic materials showed a yield point less than one-third of the cleavage strength, whereas the body-centred cubic and hexagonal metals, for the most part, showed a yield point at some intermediate position between this and the cleavage stress, so that on rapid straining or testing at very low temperatures the stress/strain curve cut the cleavage-stress curve, resulting in brittle fracture. The ductile-brittle transition is easily determined by the notched-bar impact tests or by bend tests. With these views in mind the behaviour of molybdenum was considered.

Cast ingots of molybdenum are found to be brittle at atmospheric temperatures, but the individual crystals are ductile. The effects of type of test, temperature of test, grain-size, and grain orientation were discussed, and it was shown that the transition temperature was raised by increasing the rate of testing, triaxiality of loading, and impurities such as oxygen,

nitrogen, and carbon. The improvements of mechanical working in reducing the transition temperature were emphasized, but the dangers due to preferred orientation as obtained by cross-rolling were also pointed out.

MR. E. A. G. LIDDIARD (Fulmer Research Institute), after touching on the anomalous freedom from brittleness of tantalum, suggested that the complex valency-type structure of manganese accounted for its brittleness. He described Sully's work on chromium, in which the brittle-ductile transition temperature was shown to increase with alloying additions, but was substantially independent of oxygen content. Fracture was transcrystalline.

He mentioned the possible effect of texture and surface finish on brittle fracture and described results of experiments on delayed fracture in high-tensile steels, which suggested failure by slow growth of minute cracks by unit processes to a critical size, causing rapid brittle fracture.

DR. A. A. WELLS (British Welding Research Association), dealing with brittle fracture in structures of low-carbon steel, underlined the previous speaker's reference to interaction between stress and strain curves for shear and cleavage. He agreed that the onset of cleavage could be explained in terms of suppression of shear through low temperature, triaxiality, and high strain rate, but stressed the importance which should also be attached to strain-hardening. Bechtold had shown for sintered pure molybdenum how any increase of cleavage strength with previous plastic flow was more than counterbalanced by increases of stress through strain-hardening. The same effect was evident from the results of many slow tensile tests on large and small notched specimens of carbon steel in the notch-brittle condition, since cleavage did not arise until a state of general yield had been obtained. General yield was the first stage in the loading cycle at which large plastic strains at notch roots became possible. Furthermore, under service conditions, it often so happened that cleavage was initiated from zones previously subjected to excessive cold work through operations such as cold punching and shearing. Almost spontaneous fractures from cracked welds were another case where plastic flow could be responsible for initiation, since weld metal, when cooling, was rigidly held by adjacent cold metal, and so sustained an extension equal to the free casting contraction. At the root of a crack in such a cooling zone there would be very severe plastic deformation which could set up strain-ageing as well as strain-hardening.

Another feature of interest was the limitation of brittle crack propagation for other reasons than passage of the crack into notch-tough material. Robertson had shown that a minimum externally applied stress was necessary if propagation were to continue at any temperature, and his own work was concerned with the energy for propagation. A method had been devised for measuring the surface energy of propagation by means of the heat which was evolved at the fracture surface. The quantity of heat appeared to possess a minimum value if propagation continued, and he took that to be associated with the plastic flow necessary before surfaces showing mixed shear and cleavage could be parted. The elastic energy required to create fresh brittle surface needed to be stored at the instant preceding fracture, and its availability could be estimated in any particular case by the method of Griffith. Perhaps the best example of an energy-limited fracture was shown in Docherty's experiment, in which small, notched, slow-bend specimens failed in the ductile manner, where larger geometrically similar specimens of the same material showed notch-brittle fractures, at the same temperature and strain rate.

NEWS OF KINDRED SOCIETIES

Australian Institute of Metals

The Seventh Annual Meeting of the Australian Institute of Metals was held at Port Kembla at the beginning of June. At the official opening ceremony, which was performed by the Governor General, Field Marshal Sir William Slim, a message of good wishes from the Institute of Metals was read and warmly received by the members.

The Australian Institute of Metals Annual Lecture was delivered by Mr. J. S. Smart, of the American Smelting and Refining Company, whose subject was: "Some Aspects of Continuous Casting". Mr. Clement Blazey, in his Presidential Address, dealt with "The Structure of the Copper and Copper Alloy Industry". Two technical sessions were held, and the remainder of the week was spent in visits to ferrous and non-ferrous works in the Port Kembla/Woollongong area.

Officers elected for year 1954-55 are:

President: Mr. Clement Blazey (Port Kembla).

Vice-Presidents: Professor H. K. Worner (Melbourne) and Mr. K. E. Gerard (Adelaide).

Acting Hon. Secretary: Mr. J. G. Ritchie (Melbourne).

Hon. Treasurer: Mr. E. D. Connor (Melbourne).

Professor Worner will continue to act as Chairman of the Federal Executive situated in Melbourne.

OTHER NEWS

George Kelley Readership in Metallurgy

At a meeting of Congregation held on 1 June, the University of Oxford accepted the offer of the Pressed Steel Co., Ltd., to establish a Readership in Metallurgy, in memory of the late Dr. George Kelley, who was formerly Managing Director of the Company. Dr. Kelley was an American who graduated at Harvard University, where he spent some years as a lecturer and associate professor. He joined the Pressed Steel Company in 1931, and took a great interest in industrial and economic matters and in the well-being of employees under his control. During his years at Oxford he became acquainted with many members of the University, and for his contributions to science and industry he received an honorary M.A. degree in 1943. He played a prominent part in creating the friendly relations existing between the University and the industries of modern Oxford, and it is fitting that his name should be perpetuated in connection with metallurgy, in which his chief interest lay. The Research Fellowships established by the Pressed Steel Company have provided a great stimulus to University research, and the gift of a Readership in Metallurgy is a further example of the Company's generosity. Research work in metallurgy has been carried out in the Inorganic Chemistry Laboratory, Oxford, for 28 years, and in 1949 metallography was accepted as an official supplementary subject. The George Kelley Readership marks a further stage in the establishment of metallurgy in the University, and is a great encouragement to those concerned with metallurgical science.

Magnesium Industry Council

The Magnesium Advisory Committee, which was formed early in 1952 (see *Bulletin*, 1952, 1, 69), has now been reconstituted as the Magnesium Industry Council. The Council will

continue the activities of the Committee as a consultative and advisory body, and has extended its scope through the formation of Panels of technical and commercial experts.

The purpose of the Council is to promote the production and use of magnesium and its alloys, which are the lightest metallic structural materials in general use to-day. The services of the Council are available to industry and to the Ministries responsible for the defence programme.

The present Members of the Council are: Aeroplane and Motor Aluminium Castings, Ltd., Birmetals, Ltd., Birmingham Aluminium Casting (1903) Co., Ltd., James Booth and Co., Ltd., High Duty Alloys, Ltd., International Alloys, Ltd., Kent Alloys, Ltd., Magnesium Castings and Products, Ltd., Magnesium Elektron, Ltd., Rolls Royce, Ltd., Sterling Metals, Ltd., J. Stone and Co. (Charlton), Ltd., Stone-Fry Magnesium, Ltd., and T. I. Aluminium, Ltd.

The Chairman is Mr. E. Player, Birmid Industries, Ltd., and the Secretaries, Wenham Brothers and Co., 21, Bennett's Hill, Birmingham, to whom enquiries should in the first place be addressed.

Structural Aluminium Research Scholarship

The Institution of Structural Engineers has accepted an offer by The Aluminium Development Association of a Research Scholarship to the value of £400 a year, to enable the holder to undertake research on some aspect of the application of aluminium alloys to structures. The Scholarship will be awarded in alternate years for a two-year period. It is the intention of the Council of the Institution to make the first Award in the near future in order that the successful holder may begin his investigations in October.

APPOINTMENTS VACANT

AN ENTHUSIASTIC MAN is required to develop plant and processes for new foundry techniques. The work will involve initial experimentation, development of plant and its use in the foundry. Some metallurgical and engineering knowledge is required, together with some experience of production problems. Initially the work will be concerned with the continuous casting of phosphor bronzes. Please reply giving details of experience and salary to Director of Research, Rubery Owen and Co., Ltd., Darlston, South Staffs.

A VACANCY exists for the position of Manager in the Electrolytic Refining Department of an important Midland Copper Refinery. The position calls for a man with experience in this field, capable of taking complete control, and supervising future developments. Applications from chemical engineers and physical chemists with experience in electrochemical work, or extractive metallurgy, will also be considered. The position is permanent and pensionable, and salary will be according to experience and qualifications. All applications will be treated in strict confidence. Existing staff has been informed. Box No. 367, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

CHEMIST (METALLURGIST) required by Ministry of Supply at Radway Green, near Crewe, to develop control of metallurgical operations in routine production of Small Arms Ammunition Factory. Investigation of ferrous and non-ferrous problems arising in the course of production and experimental development of drawn components. Qualifications: British of British parents. Hons. degree metallurgy or A.I.M. or equivalent. Practical experience of laboratory and investigational work and supervision of staff. Salary: Within £620 (age 25)—£960 according to age. Not established but opportunities to compete for establishment may arise. Applications from M.L.N.S., Technical and Scientific Register, (K), 26 King Street, London, S.W.1, quoting F.31/54A.

APPOINTMENTS VACANT

DEPUTY CHIEF METALLURGIST. An experienced Metallurgist is required for the above responsible and progressive position. Age preferably between 30 and 35, with at least Second Class Honours degree or equivalent. Salary £1000-£1400 per annum, according to qualifications. Apply Personnel Manager, McKechnie Brothers, Ltd., Rotton Park Street, Birmingham 16.

METALLURGIST required for a variety of development projects in non-ferrous plant in North London. Short-term experimental work followed by pilot-plant operation and laboratory investigation. Qualifications necessary, B.Sc. or equivalent with industrial experience. Pension scheme available, permanent position with excellent prospects. Write giving details of qualifications and experience to Box No. 368, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

METALLURGIST required to handle problems connected with the production of non-ferrous sheet, strip and sections. Applicant should have a degree or equivalent qualification and preferably some industrial experience. High degree of initiative essential. Permanent position; staff pension scheme; salary according to qualifications and experience. Apply by letter, giving full particulars, to Labour Manager, Enfield Rolling Mills, Ltd., Brimsdown, Enfield, Middx.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester 17, has a vacancy for an assistant spectrographer in the metallurgical laboratory. Applicants should have B.Sc. and be interested in spectrographic techniques. Previous spectrographic or metallurgical experience an advantage. Salary, according to age, qualifications, and experience, will be progressive. Write to the Personnel Manager, giving full particulars including age, sex, nationality, education, and experience.

NELSON RESEARCH LABORATORIES, THE ENGLISH ELECTRIC CO., LTD., Stafford, have a vacancy for a graduate or equivalent in Applied Science or Technology. The post will include both fundamental and development work on the processing and use of materials in high vacua. Applicants should have an interest in or previous experience of materials technology. Reply quoting Ref. 1336A to Dept. C.P.S., 336/7, Strand, London, W.C.2.

THE IRON AND STEEL INSTITUTE requires young Metallurgist, male or female, as assistant in Information Department. Academic training, and an interest in documentation, essential, works or research experience, and a knowledge of technical French or German, desirable. Apply in writing, stating qualifications, experience, age, and salary required, to the Secretary, 4, Grosvenor Gardens, London, S.W.1.

TITANIUM. There are a few graduate vacancies in a team concerned both with titanium research and production melting. Unusual opportunity for enterprising metallurgical and engineering graduates. Please give full details of qualifications, experience, salary, requirements, to Box 369, The Institute of Metals, 4, Grosvenor Gardens, London, S.W.1.

WORKS MANAGER is required for a wrought brass and copper factory in the Birmingham area employing about 800 men. Management experience and either metallurgical or mechanical engineering qualifications are essential. Applications, which will be treated in confidence, should give full details of qualifications, experience, age, and salary required, and should be addressed to Managing Director, Box No. 1283, Technical and General Advertising Agency, Ltd., 167 High Holborn, London, W.C.1.

UNIVERSITY OF BIRMINGHAM.

Applications are invited for admission to the Graduate Course in Metallurgy in October 1954, from men holding degrees or equivalent qualifications in metallurgy, physics, chemistry, or engineering. The course provides a year's training in industrial metallurgy at a post-graduate level for men who are engaged in, or preparing to enter, metallurgical industry. On satisfactory completion of the course candidates are awarded the Diploma in Graduate Studies (Metallurgy). Candidates holding a suitable first degree who complete the course successfully and submit an approved dissertation qualify for the Degree of Master of Science. The inclusive fee for the course is £71 1s.; in suitable cases a maintenance allowance may be given. Full particulars may be obtained from The Registrar, The University, Edgbaston, Birmingham 15.